

WHAT IS CLAIMED IS:

1. An optical element, comprising:
 - a first voltage application electrode;
 - 5 a first opposing electrode arranged in opposition to the first voltage application electrode; and
 - a first phase changing layer arranged between the first voltage application electrode and the first opposing electrode;
 - wherein, by changing a voltage between the first voltage application
 - 10 electrode and the first opposing electrode, a phase that converts plane waves into spherical waves is imparted on light that is incident on the first phase changing layer.
2. The optical element according to Claim 1, wherein at least one
- 15 electrode selected from the first voltage application electrode and the first opposing electrode is arranged on a curved surface.
3. The optical element according to Claim 1, wherein the first phase changing layer is made of a material whose refractive index changes when
- 20 applying a voltage.
4. The optical element according to Claim 3, wherein the first phase changing layer is made of a liquid crystal.
5. The optical element according to Claim 1, wherein the first phase changing layer is made of a material whose volume changes when subjected
- 25 to a voltage.
6. The optical element according to Claim 5, wherein the first phase
- 30 changing layer is made of PLZT.
7. The optical element according to Claim 1, wherein the first voltage application electrode includes a plurality of segment electrodes.
8. The optical element according to Claim 1, further comprising:
 - a second voltage application electrode;
 - a second opposing electrode arranged in opposition to the second

voltage application electrode; and

a second phase changing layer arranged between the second voltage application electrode and the second opposing electrode;

5 wherein, by changing a voltage between the second voltage application electrode and the second opposing electrode, a phase that converts plane waves into spherical waves is imparted on polarized light that is perpendicular to the polarization of the light that is incident on the first phase changing layer.

10 9. The optical element according to Claim 8, wherein at least one electrode selected from the second voltage application electrode and the second opposing electrode is arranged on a curved surface.

15 10. The optical element according to Claim 8, wherein the second phase changing layer is made of a material whose refractive index changes when applying a voltage between the second voltage application electrode and the second opposing electrode.

20 11. The optical element according to Claim 8, wherein the second phase changing layer is made of a material whose volume changes when applying a voltage between the second voltage application electrode and the second opposing electrode.

25 12. The optical element according to Claim 8, wherein the second voltage application electrode includes a plurality of segment electrodes.

13. An optical head for recording or reproducing signals on an optical recording medium, the optical head comprising:

30 a light source;
an optical element arranged between the optical recording medium and the light source; and

an objective lens arranged between the optical recording medium and the optical element;

35 wherein the optical element is the optical element according to Claim 1.

14. The optical head according to Claim 13, further comprising an N/4

wavelength plate (wherein N is an odd number of one or greater) arranged between the optical element and the objective lens.

15. An optical recording/reproducing apparatus for recording or
5 reproducing signals on an optical recording medium, the optical
recording/reproducing apparatus comprising:

an optical head for recording or reproducing signals on an optical
recording medium, the optical head comprising:

a light source;

10 an optical element arranged between the optical recording
medium and the light source; and

an objective lens arranged between the optical recording
medium and the optical element;

15 wherein the optical element is the optical element according to Claim
1.

16. An optical recording/reproducing apparatus for recording or
reproducing signals on a first optical recording medium including only one
recording layer and on a second optical recording medium including a
20 plurality of recording layers, the optical recording/reproducing apparatus
comprising:

an optical head for recording or reproducing signals on the first and
second optical recording media, the optical head comprising:

a light source; and

25 a spherical aberration correction means arranged between
the optical recording medium and the light source;

wherein a distance from a surface of the first optical recording
medium to the one recording layer A included in the first optical recording
medium is substantially the same as the distance from a surface of the
30 second optical recording medium to one recording layer B included in the
second optical recording medium.

17. The optical recording/reproducing apparatus of Claim 16, wherein, in
an initial state before recording or reproducing signals on the first or the
35 second optical recording medium, the spherical aberration correction means
is driven so as to correct spherical aberration of the recording layer A.

18. The optical recording/reproducing apparatus of Claim 17, wherein,
when recording or reproducing signals on a recording layer C of the second
optical recording medium, which is different from the recording layer B, the
spherical aberration correction means is driven so as to correct spherical
5 aberration of that recording layer C.

19. The optical recording/reproducing apparatus of Claim 17, further
comprising a focus control means;
wherein, in the initial state, after driving the spherical aberration
10 correction means so as to correct spherical aberration of the recording layer
A, focus control is performed with the focus control means.

20. The optical recording/reproducing apparatus of Claim 17, wherein
administrative information of the second optical recording medium is stored
15 in the recording layer B.

21. An optical recording/reproducing apparatus for recording or
reproducing signals on a first optical recording medium including only one
recording layer and on a second optical recording medium including a
20 plurality of recording layers, the optical recording/reproducing apparatus
comprising:

a light source;
a spherical aberration correction means arranged between the optical
recording medium and the light source;
25 a focus error detection means; and
a focus control means;

wherein, in an initial state before recording or reproducing signals on
the first or the second optical recording medium, the spherical aberration
correction means is driven so as to correct spherical aberration of the
30 recording layer included in the first optical recording medium, then, a focus
error is detected with the focus error detection means, and focus control is
performed with the focus control means, based on the detected focus error.

22. An optical recording/reproducing apparatus for recording or
35 reproducing signals on a first optical recording medium including only one
recording layer and on a second optical recording medium including a
plurality of recording layers, the optical recording/reproducing apparatus

comprising:

a light source;

a spherical aberration correction means arranged between the optical recording medium and the light source;

5 a focus error detection means; and

a focus control means;

wherein, if it is known whether the optical recording medium subjected to recording or reproducing is a first optical recording medium or a second optical recording medium, then the spherical aberration correction means is driven so as to correct spherical aberration at a standard base material thickness of the recording layer subjected to recording or reproducing, then, a focus error is detected with the focus error detection means, and focus control is performed with the focus control means, based on the detected focus error.

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23. A recording/reproducing method for recording or reproducing signals with an optical recording/reproducing apparatus on a first optical recording medium including only one recording layer and on a second optical recording medium including a plurality of recording layers,

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wherein the optical recording/reproducing apparatus includes a spherical aberration correction means;

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wherein a distance from a surface of the first optical recording medium to the one recording layer A included in the first optical recording medium is substantially the same as the distance from a surface of the second optical recording medium to one recording layer B included in the second optical recording medium; and

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wherein the method includes a first step of driving the spherical aberration correction means so as to correct spherical aberration of the recording layer A, before recording or reproducing.

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24. The recording/reproducing method according to Claim 23, further including a second step, carried out after the first step, wherein, when recording or reproducing signals on a recording layer C of the second optical recording medium, which is different from the recording layer B, the spherical aberration correction means is driven so as to correct spherical aberration of that recording layer C.

25. An optical recording/reproducing method for recording or reproducing signals with an optical recording/reproducing apparatus on a first optical recording medium including only one recording layer and on a second optical recording medium including a plurality of recording layers,

5 wherein the optical recording/reproducing apparatus includes a spherical aberration correction means, a focus error detection means, and a focus control means;

the method comprising:

10 a first step of driving the spherical aberration correction means so as to correct spherical aberration of the recording layer included in the first optical recording medium;

a second step of detecting a focus error with the focus error detection means; and

15 a third step of performing focus control with the focus control means, based on the detected focus error;

wherein the first, second and third step are carried out before recording or reproducing.

26. An optical recording/reproducing method for recording or reproducing signals with an optical recording/reproducing apparatus on a first optical recording medium including only one recording layer and on a second optical recording medium including a plurality of recording layers,

20 wherein the optical recording/reproducing apparatus includes a spherical aberration correction means, a focus error detection means, and a focus control means;

25 the method comprising:

a first step of acquiring information about whether the optical recording medium subjected to recording or reproducing is a first optical recording medium or a second optical recording medium;

30 a second step of driving the spherical aberration correction means so as to correct spherical aberration at a standard base material thickness of the recording layer subjected to recording or reproducing, based on that information;

35 a third step of detecting a focus error with the focus error detection means; and

a fourth step of performing focus control with the focus control means, based on the detected focus error;

wherein the first, second, third, and fourth step are carried out before recording or reproducing.

43